

MEASURING THE VALUE OF “GREEN” FOREIGN DIRECT INVESTMENT IN THE UNITED KINGDOM

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Abstract

This paper presents an experimental methodology and a first estimate of “Green” Foreign Direct Investment (GFDI) in the United Kingdom. The paper makes use of microdata from two ONS surveys – Foreign Direct Investment (FDI) and the Annual Business Survey (ABS). The experimental results suggest that the stock of overseas FDI into the UK held in environmental assets was £8.1 billion in 2013, or 0.8% of the total.

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Background

Foreign Direct Investment

Foreign Direct Investment (FDI) refers to cross-border investments made by residents and firms from one country into another, with the aim of establishing a lasting interest in the firm receiving investment. The basic criterion used is ownership of at least 10% of the voting power, representing the influence by the investor (OECD Factbook, 2013).

FDI statistics published by the Office for National Statistics (ONS) cover all cross-border transactions: earnings, positions, and flows. Investment positions refer to the value of the stock of cross-border investment; UK owned assets abroad are referred to as UK FDI assets, while assets owned by overseas investors but held in the UK are referred to as UK FDI liabilities.

Green Foreign Direct Investment (GFDI) positions by overseas investors in the UK, or liabilities, are the focus of this paper. Data presented use the asset & liability measurement principle and are consistent with Balance of Payments, and the values are based on Net Book Value (NBV).

The paper focuses on inward GFDI as the ONS currently only holds environmental data regarding firms residing in the UK.

Green Growth Strategy

At the 2009 OECD Ministerial Council Meeting, ministers recognized that:

“Economic recovery and socially sustainable economic growth are key challenges that all countries are facing today... Green growth will be relevant going beyond the current crisis, addressing urgent challenges including the fight against climate change and environmental degradation, enhancement of energy security, and the creation of new engines for economic growth.”

To provide a response to those challenges, ministers asked the OECD to develop a Green Growth Strategy with recommendations on how countries can achieve economic growth and development, while at the same time moving towards a low-carbon economy, reducing pollution, minimizing waste and inefficient use of natural resources, and maintaining biodiversity.

An important pillar of the OECD Green Growth Strategy is the development of green growth indicators in order to monitor progress (see Chapter IV on “How do we measure progress towards green growth” of the [OECD Green Growth Strategy Interim Report](#)). Five major areas have been highlighted as critical for green growth: (i) environmental efficiency of production, (ii) environmental contents of consumption, (iii) natural resource stocks and biodiversity, (iv) environmental quality of life, and (v) policy responses and instruments. This last area includes indicators on international transfers, among which includes international investments.

In October 2010, the Working Group on International Investment Statistics (WGIIS) agreed to contribute to the Investment Committee exercise aiming to define and measure GFDI, and to incorporate this work in its globalisation research agenda. WGIIS also endorsed the proposal to conduct this research work with the guidance of an electronic discussion group (EDG) composed of selected WGIIS members.

This document presents a first trial of a multi-faceted approach to measuring UK GFDI, which includes components that are derived by linking records between an internal database of environmental establishments and an FDI database. The paper's main purpose is to present an experimental approach for measuring Green FDI, with the aim of complementing the existing, yet scarce, literature. Since no agreed international guidelines have yet been set for producing Green FDI statistics, all estimates produced in this paper are subject to change.

Definition of "Green"

The UK uses Eurostat's definition of environmental goods and services sector.

The ONS follows the same definition of an environmental establishment provided by OECD/Eurostat in the [Environmental Goods & Services Industry Manual for Data Collection and Analysis](#):

"The environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air, and soil as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services which reduce environmental risk and minimize pollution and resource use."

The Environmental Sector in the UK

The creation of a new UK database of establishments in the environmental sector

In 2013, the ONS included a new question on the Annual Business Survey (ABS), regarding Environmental Goods and Services (EGSS), in an effort to create an environmental database of firms that produced a good or service with the main aim of protecting the environment. This used the wording presented in Figure 1.

This question relates to turnover, however, is used in this paper as an estimate for the value of FDI undertaken by overseas investors in the UK. Analysis undertaken by ONS showed that turnover had a stronger relationship with FDI positions when compared to other FDI variables¹.

Figure 1. Environmental questions added to the ABS.

(a) Did your business produce a good and or service with the main aim of protecting the environment?		
YES <input checked="" type="checkbox"/>	→ Go to question 3.4 (b)	NO <input checked="" type="checkbox"/> → Go to question 4
(b) Please estimate the proportion of your total turnover that relates to the environmental good or service produced.		
0 - 24% <input checked="" type="checkbox"/>	25 - 49% <input checked="" type="checkbox"/>	50 - 100% <input checked="" type="checkbox"/>

The survey was returned by over 51,000 firms, of which approximately 1,600 responded positively, confirming environmental turnover. All positive responses were quality assured and allocated to CEPA (Classification of Environmental Protection Activities) and CReMA (Classification of Resource Management Activities) classifications. At present, this database is relatively small compared to the real number of existing environmental firms, as ONS only have the results from one run of the survey so far. The database will continue to grow each year as new firms respond to the ABS survey.

The question was expanded in the 2014 ABS to provide more guidance regarding how to answer the question, with the number of environmental percentage brackets increased. An example of the new question can be found in Annex A.

Please note that the EGSS question responses for 2013 used throughout this paper were not individually validated at time of publication, and are therefore subject to change once the final estimates are prepared towards the end of 2016.

¹ With a Pearson's correlation coefficient of 0.41.

Resources Available

2013 FDI Population data

Information from the FDI survey is used to measure direct investment positions, flows and earnings for the UK Balance of Payments.

[FDI statistics](#) provide information on the stock of investment which overseas investors hold in the UK, the change in stocks between periods, and the earnings these investments generate. The inward FDI population consists of over 20,000 firms that are in receipt of FDI.

All FDI data presented in this paper are consistent with [Balance of Payments, Quarter 4 \(October to December\) 2015](#).

2013 Annual Business Survey (ABS) Sample data

The [ABS](#) is one of the main structural business surveys conducted by ONS. It collects financial information for the UK non-financial business economy. The variables collected include turnover, purchases, employment costs, capital expenditure and stocks.

The EGSS question discussed in section 2 was introduced into the ABS in 2013. This is the most recently collected data, so only this 2013 sample data can be used to assign environmental percentages.

Inter-Departmental Business Register (IDBR) business name data

The IDBR is a comprehensive database of over 2.1 million UK firms, used by various government departments for statistical purposes. For ONS, the database provides the main sampling frame for many of its business surveys.

Low Carbon and Renewable Energy Economy Survey (LCS)

The LCS is a new survey designed to collect information from firms working within the green economy, including low carbon and renewable energy activities. UK government departments and devolved administrations will use this information to assess and develop policies relating to green job creation, and potential growth and investment opportunities both nationally and regionally.

The sample consists of around 40,000 firms. LCS data were not readily available at the time of writing but will be incorporated in future attempts to measure Green Foreign Direct Investment.

Methodology

Overview

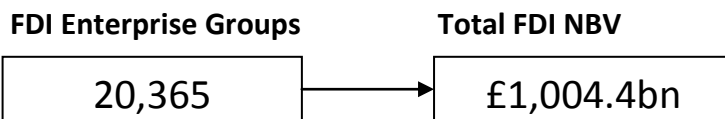
GFDI is measured in terms of the environmental proportion of total FDI investment stocks. This is either the full value of FDI by firms involved solely in environmental activities, or a proportion of the total FDI that is environmental.

GFDI is estimated in this paper by deriving 3 additive components:

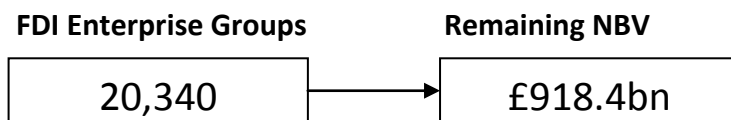
- Component 1 relates to firms with an “environmental” Standard Industrial Classification (SIC).
- Component 2 relates to firms in both the FDI and ABS datasets, which responded positively to the EGSS question.
- Component 3 relates to firms investing in environmental assets in the FDI dataset that have not been matched onto the ABS dataset.

$$GFDI = Comp\ 1 + Comp\ 2 + Comp\ 3$$

There were 20,365 enterprise groups in the FDI system in 2013, with a combined Inward NBV of £1,004.4 billion.



Before estimating a green proportion of FDI, data pertaining to financial intermediaries is removed because it assumed not to comprise any environmental assets.



Component 1: Affiliates operating in environmental industries

Component 1 relates to firms with an environmental Standard Industrial Classification (SIC) within the FDI population database. This paper makes use of Eurostat's definition of an environmental industry, which are made up of the following SIC codes:

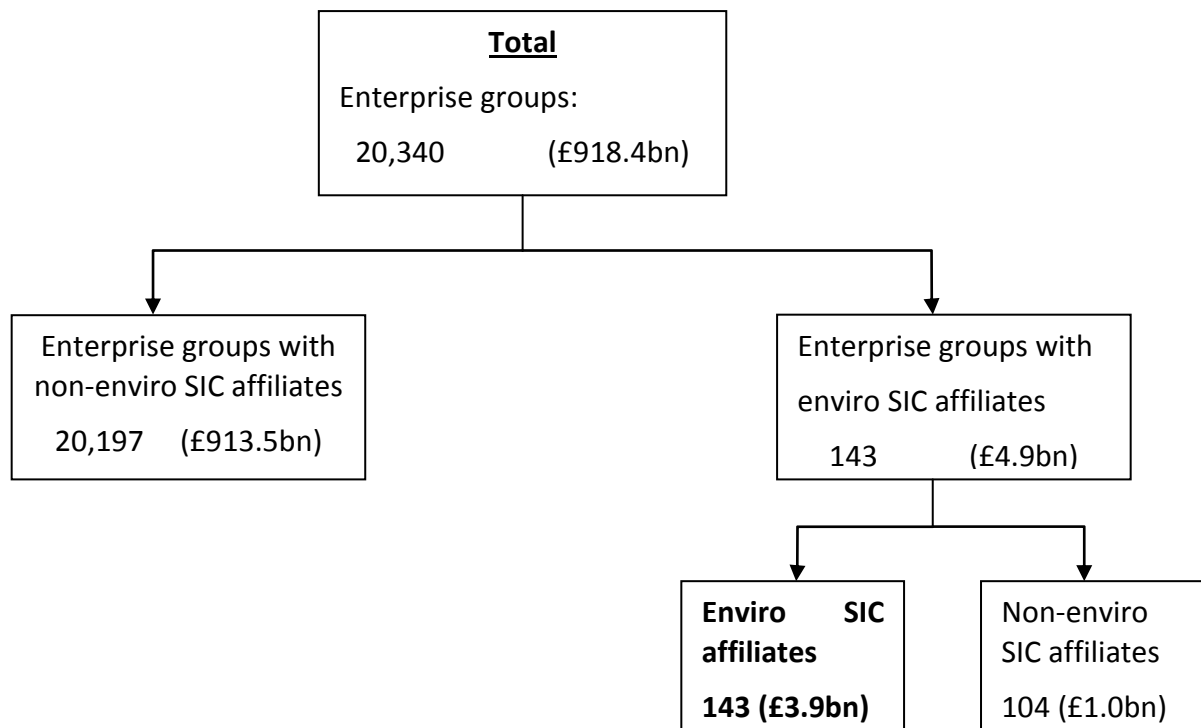
36 - Water collection, treatment and supply

37 - Sewerage

38 - Waste collection, treatment and disposal activities; materials recovery

39 - Remediation activities and other waste management services

All enterprise groups that own affiliates with an environmental SIC are separated from the FDI dataset. This subset is then divided into those affiliates with an environmental SIC and those without. All FDI values of affiliates with environmental SICs are recorded as GFDI, while none of the FDI values belonging to affiliates with non-environmental SICs are considered GFDI.



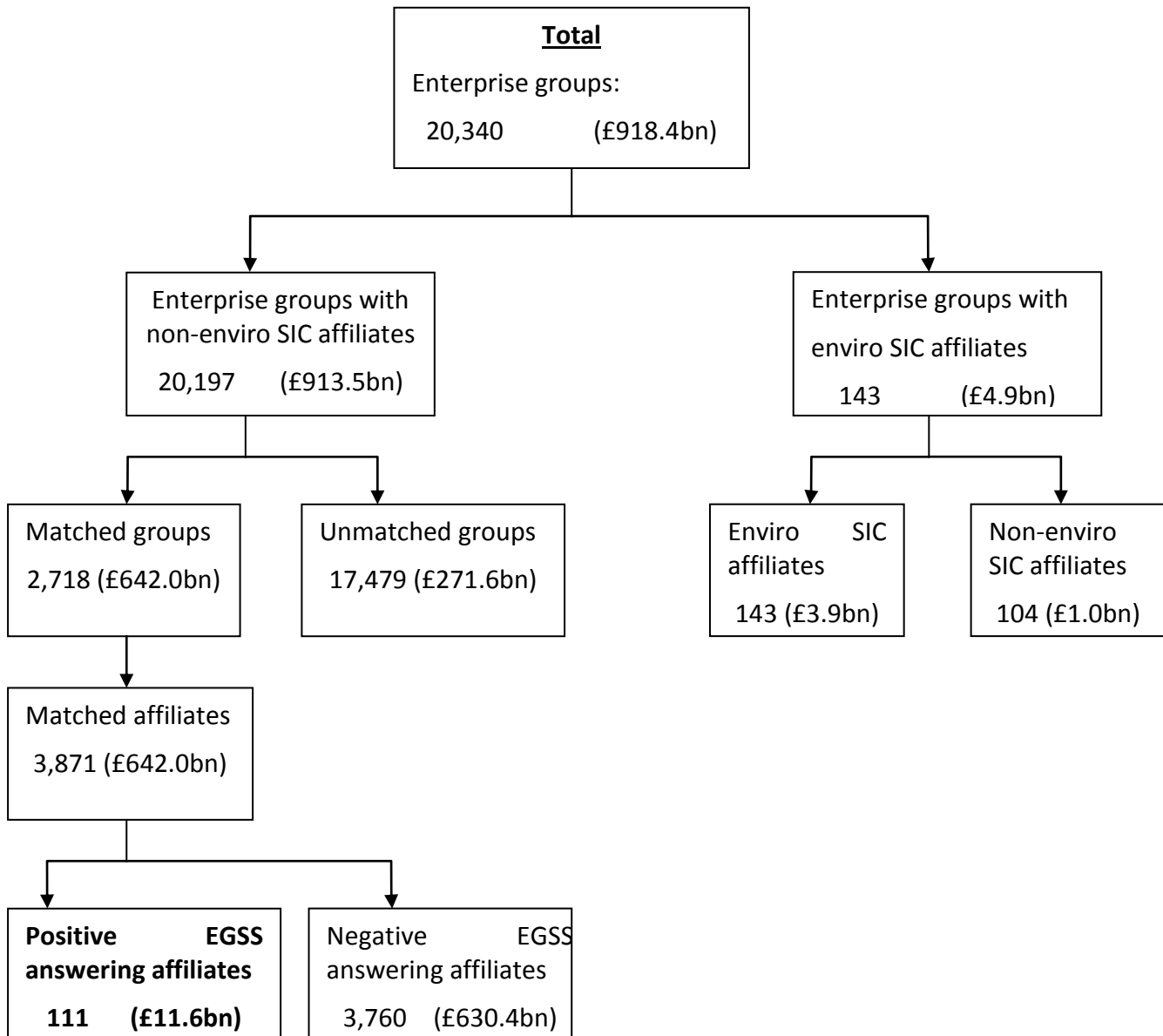
GFDI for component 1 = £3.9 billion

All enterprise groups with any environmental affiliates are not included in Component 1 and Component 2 to avoid double counting when matching to the ABS survey.

Component 2: Matched FDI-ABS survey responses

Component 2 relates to firms that have answered positively to the EGSS question on the ABS survey. Records from the ABS survey are matched to the remaining FDI population (excluding those accounted for in Component 1) to estimate the proportion of environmental FDI using the EGSS question.

Of the matched records between the FDI survey and ABS, 111 answered positively to the EGSS question, while 3,760 answered negatively.



Each of the firms that answered positively to the EGSS question selected a percentage band of 0-24%, 25-49% or 50-100% to estimate the proportion of their turnover that is accounted for by the environmental goods or services they produced. This was used to assign each affiliate an

“environmental percentage” that is in the middle of each percentage band – 12, 37% and 75%². Sensitivity analysis is presented in section 6 to demonstrate how the estimate changes depending on the environmental percentage assigned.

FDI values for each firm are multiplied by their respective environmental percentages to provide an estimate for GFDI.



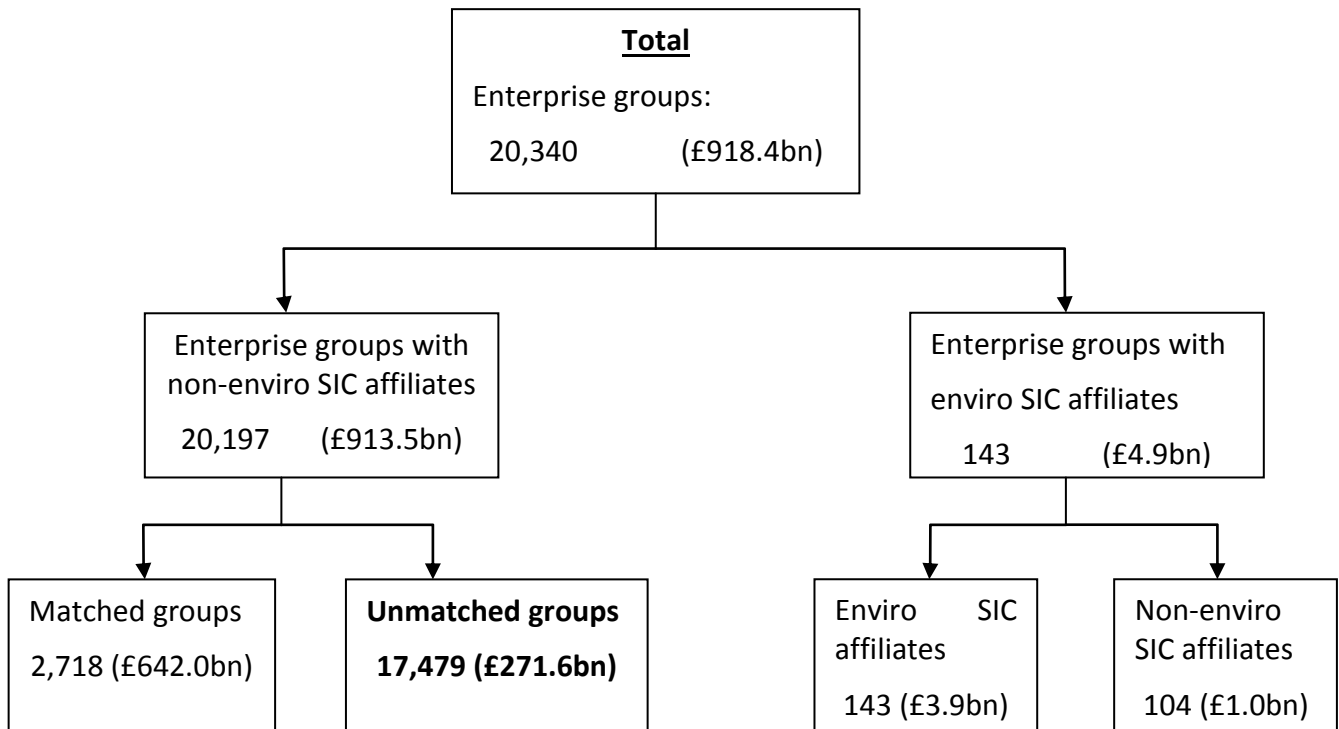
GFDI for component 2 = £2.5 billion

² This approach assumes observations are centred on the middle point of each band. An alternative approach is to use the Shepphard’s Correction method, which adjusts estimates by assuming data are spread evenly in each band.

Component 3: Estimation of remaining FDI records

The third component relates to the remaining firms in the FDI dataset that have not been accounted for in Component 1 or Component 2, as they do not have affiliates with environmental SICs and were not matched to the ABS.

The FDI values for the population excluding financial intermediaries and firms in Component 1 sum to £913.5 billion. Firms that were matched to the ABS (Component 2) accounted for approximately 70% of the total FDI value, while the unmatched dataset accounted for the remainder.



Remaining FDI value - £913.5 billion

Matched groups - 70.3%	Unmatched groups - 29.7%
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A scaling factor is derived using the matched dataset to estimate the GFDI of the remaining firms in the FDI dataset that were not accounted for in Component 1 or Component 2. Three alternative methods are presented in this paper to estimate the value of GFDI in the unmatched dataset: weighted estimation, post-stratification ratio estimation, and conditional ratio estimation.

Method 1 – Weighted Estimation

This method makes use of the ABS' weighted estimation method; a standard statistical techniques for stratified random sampling³. Each sampled business in the ABS is weighted by its design weight (a-weight) and a calibration factor, which is calculated using ratio estimation (g-weight). The a-weight represents the number of similar businesses that each sampled business represents. The g-weight improves the precision of the estimates and corrects for any imbalance in the selected sample by taking account of characteristics of the businesses that were randomly selected.

Firms that are in receipt of FDI, were matched onto the ABS survey and responded positively to the EGSS question have their corresponding GFDI values scaled up using their a-weights and g-weights from the ABS survey to produce an estimate for the overall population.

$$\sum (GFDI_{matchedpos} \times a - weight \times g - weight)$$

Where:

$GFDI_{matchpos}$ is each firm's corresponding value of GFDI for matched ABS-FDI records that responded positively to the EGSS question.

$a - weight$ is each firm's corresponding design weight from the ABS survey.

$g - weight$ is each firm's calibration factor from the ABS survey.

Method 1 provides a combined estimate of £7.8 billion for components 2 and 3, or £5.2 billion for Component 3 alone. However, a large proportion of this value was driven by one firm that had a particularly large design weight. Given the small domain, the standard errors of these weights for the purposes of this estimate are likely to be large; therefore this particular firm's weight was assumed an outlier and overwritten to one. This reduced the Component 3's estimate to £2.2 billion.

This method provides a GFDI estimate of £2.2 billion for Component 3.

³ Further information on the ABS' estimation methods are found [here](#).

Method 2 – Post-stratification Ratio Estimation

This method stratifies matched data based on the value of FDI positions, and calculates a ratio of GFDI to the total the FDI of the matched data set. This ratio is then applied to the unmatched dataset, which is stratified in the same way as the matched dataset.

$$\left(\sum \left(\frac{GFDI_{match}^{strata 1}}{FDI_{match}^{strata 1}} \right) \times \sum FDI_{unmatch}^{strata 1} \right) + \left(\sum \left(\frac{GFDI_{match}^{strata 2}}{FDI_{match}^{strata 2}} \right) \times \sum FDI_{unmatch}^{strata 2} \right)$$

Where:

$GFDI_{match}^{strata 1}$ is the value of GFDI for matched ABS-FDI records belonging to the first stratum (bottom three quartiles).

$FDI_{match}^{strata 1}$ is the value of FDI for matched ABS-FDI records belonging to the first stratum.

$FDI_{unmatch}^{strata 1}$ is the value of FDI for non-matched records belonging to the first stratum.

$GFDI_{match}^{strata 2}$ is the value of GFDI matched ABS-FDI records belonging to the second stratum (top quartile).

$FDI_{match}^{strata 2}$ is the value of FDI for matched ABS-FDI records belonging to the second stratum.

$FDI_{unmatch}^{strata 2}$ is the value of FDI for non-matched records belonging to the second stratum.

After conducting significance testing on different possible stratum of the FDI positions, the data was stratified into two: the bottom three quartiles and the top quartile.

This method provides a GFDI estimate of £1.5 billion for Component 3.

Method 3 – Conditional Ratio Estimation

The conditional ratio estimation method computes a ratio of GFDI to total FDI of firms answering positively to the EGSS question, and estimates the propensity of occurrence for firms answering positively to the EGSS question. The ratio and probability of a positive answer are then used to estimate the value of GFDI for the remaining unmatched FDI population.

$$\sum \left(\frac{GFDI_{matchpos}}{FDI_{matchpos}} \right) \times \left(\frac{n_{matchpos}}{n_{match}} \right) \times \sum FDI_{unmatched}$$

Where:

$GFDI_{matchpos}$ is the value of GFDI for matched ABS-FDI records that responded positively to the EGSS question.

$FDI_{matchpos}$ is the value of FDI for matched ABS-FDI records.

$n_{matchpos}$ is the number of matched ABS-FDI records that responded positively to the EGSS question.

n_{match} is the number of matched ABS-FDI records.

$FDI_{unmatched}$ is the value of FDI for the non-matched records

This method provides a GFDI estimate of £1.7 billion for Component 3.

After conducting analysis on methods 2 and 3, the conditional ratio estimator was found to be the most accurate⁴. The conditional ratio estimator method is therefore used for the final estimation in this paper⁵.

GFDI for Component 3 = £1.7 billion

Sum of Components

The sum of the three components creates an estimate for GFDI of £8.1 billion, or 0.8% of the total value of the stock of FDI into the UK.

Sensitivity Analysis

Components 2 and 3 are sensitive to the environmental percentages assigned from the EGSS question. To produce an estimate, the central percentage of each band was used: 12% for 0-24%; 37% for 25-49% and 75% for 50-100%.

It is possible that the average for each band may range between 1%, 25% & 50% and 24%, 49% & 100%. Table 1 presents alternative GFDI estimates based on differing assumptions regarding the environmental percentage. The estimates provide an idea of the probable range of values for GFDI, which has been estimated to be between 5.6% and 10.6% of total FDI, depending on which percentage is chosen.

Table 1: Sensitivity analysis

Assumption	Percentage (%)	Total GFDI (£bn)	Percentage of Total FDI NBV (%)
Maximum	(24,49,100)	10.6	1.06
Higher	(17,42,90)	9.3	0.92
Central	(12,37,75)	8.1	0.81
Lower	(7,32,65)	7.0	0.70
Minimum	(1,25,50)	5.6	0.56

⁴ Based on which method provided the smallest mean square error.

⁵ Method 1 was not used due to the assumptions that had to be made relating to omitted outliers.

Annex A

2014 EGSS Question

(a) Does your business produce good(s) and/or service(s) that protects the environment?

Include: goods and/or services produced by your business

- **eg** the production or installation of solar panels.
- **eg** waste collection, treatment and disposal services.
- **eg** environmental consultancy and training services.

Exclude: goods and/or services used by your business

- **eg** the use of energy saving light bulbs
- **eg** the consumption of recycled materials

YES → Go to question 3.4 (b)

NO → Go to question 4

(b) What proportion of your total turnover relates to the environmental good(s) and/or services produced?

0 - 9% 10 - 24% 25 - 49% 50 - 74% 75 - 100%

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